

The Design and Performance of the New Toroidal Mirror for ID09 (ESRF)

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Abstract

ID09 is a dual-purpose beamline dedicated to time-resolved and high-pressure experiments. The time-resolved experiments use a high-speed chopper to isolate single pulses of x-rays. The chopper is installed near the sample (focal spot) and the shortest usable opening time depends on the sharpness of the vertical focusing. In the 16-bunch mode, for example, the height of the chopper tunnel has to be as small as 0.145 mm to produce a 0.3 μ s opening window (900 Hz rotation). To enhance the pulsed flux on the sample, we have therefore built a high precision mirror that focuses the beam 22.4 m downstream in $M=0.67$ geometry. The 1.0-m long silicon mirror is bent by gravity into a toroid with a meridional radius of 9.9 km. The curvature is fine-tuned by a push & pull stepper motor that works from below the mirror. The figure error from the sag and the correcting force is less than ± 0.3 μ rad and the polishing error is as small as 0.7 μ rad (rms) over the central 450-mm of the mirror. The observed focal spot in the polychromatic focus is 0.100 x 0.070 mmh x mmv. This performance is the result of high quality polishing, a strain-free holder and a low-vibration cooling system.

Keywords: toroidal mirror, gravity, slope error and bender

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